

Analysis of Cancer Incidence Data in Coldwater Creek Area, Missouri, 1996-2004

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Executive Summary

One of the top priorities of the Missouri Department of Health and Senior Services (DHSS) is to ensure Missourians are healthy, safe and informed. When individuals and communities have personal and difficult health concerns they often seek our assistance to find answers. We take this responsibility very seriously. To accomplish this, DHSS translates data and evidence-based practices into practical information to help individuals understand and take appropriate action on issues of public health.

Regarding cancer concerns, DHSS uses a systematic, multi-disciplinary approach to gather and evaluate data, draw scientifically sound conclusions and provide recommendations that promote and protect public health. As part of ongoing surveillance and in response to community concerns, DHSS has completed a review of cancer incidence in the area around Coldwater Creek.

Coldwater Creek is adjacent to several sites in the St. Louis, MO, area which were involved in the processing and recovery of uranium during World War II. These sites were contaminated with radioactive waste as a result of those activities. Several other federal and state agencies are involved in ongoing environmental cleanup actions at these sites. DHSS will remain in a public health oversight role for ongoing environmental actions at these sites to assess public health concerns. While most of the radioactive wastes have been cleaned up, citizens have expressed concern that exposure to the wastes has increased the number of cancer cases in the area.

DHSS's efforts of monitoring the incidence and mortality of cancers in the Coldwater Creek area extend back at least 25 years. In this current analysis, the observed numbers of incident cases for 27 types of cancer and all cancers combined in the Coldwater Creek area were compared to the expected numbers of cases based on the incidence rates for the State of Missouri during 1996-2004. These numerous types of cancer were evaluated in an effort to be as complete as possible.

Authoritative cancer epidemiology research associates leukemia and thyroid cancers to specific environmental sources of radiation. Our current analysis, however, found that leukemia incidence is not significantly higher, and thyroid cancer incidence is significantly lower than expected. Taken together, these results indicate that an increased cancer risk in the population due to environmental radiation exposure is unlikely.

Several types of cancer were found at significantly higher incidence rates than expected, including female breast, colon, prostate and kidney. Other cancers showed results lower than expected. While female breast cancer can be associated with radiation, there is minimal evidence for low to moderate level environmental radiation exposure as a risk factor share. The cancer rates that are elevated do share several common risk factors, such as smoking, physical inactivity, unhealthy diets, and diabetes. Some of these risk factors may help explain those findings.

As a result of this analysis, the DHSS cancer inquiry committee recommends the state and local public health agencies increase cancer prevention and health promotion efforts in the area. Efforts should be targeted to promote healthy eating, regular physical activity and tobacco control. These actions are expected to have the greatest positive impact on cancer prevention in the community.

No matter what the cause or concern in the area, DHSS remains dedicated to addressing the public health concerns of community members.

A note regarding cancer cluster concerns and the environment:

It is not uncommon for individuals or communities to become concerned about a perceived excess of cancer or other chronic disease. These concerns are often reported to state and local health agencies with an expectation that a causal link to a common identifiable risk factor will be found. While conclusive findings are rare in any cluster investigation, DHSS uses a systematic, multi-disciplinary approach, consistent with national guidelines, to determine if a perceived excess is real. As important to the scientific cancer inquiry process is the opportunity to provide critical health information to the individuals and communities we serve.

- Cancer is not one disease. Different cancers, like other chronic diseases, have different causes and risk factors.
- Cancer is very common. More than 1 in 3 women and nearly 1 in 2 men will be affected by some type of cancer in their lifetime.
- Age, family history (genetics) and lifestyle factors (diet, exercise, alcohol or tobacco use) are usually more important risk factors for cancer than environmental contamination.
- Clustering can still be a random occurrence, even when statistical tests indicate that cancer cases are higher than expected.

Site History

The Formerly Utilized Sites Remedial Action Program (FUSRAP) is an environmental remediation program established by the U.S. government. The purpose of the program is to address radiological contamination from activities by the Manhattan Engineering District and Atomic Energy Commission during atomic bomb development in the 1940s through 1960s. As a part of these projects, the Mallinckrodt facility in downtown St. Louis was contracted by the U.S. government to extract uranium from ore so it could be sent to other facilities. The extracted uranium was then sent to other facilities for enrichment, such as Oak Ridge National Laboratory in Tennessee. The site in downtown St. Louis operated from 1942-1957.

During the course of the operations, waste materials were stockpiled at a site in North St. Louis County located close to Lambert International Airport. This site became known as the St. Louis Airport Site (SLAPS). In the 1960s and 1970s, some of the waste material (which could potentially have been recycled) was sold by the AEC to a private company, which transported the material to another location north of the SLAPS. This site became known as the Hazelwood Interim Storage Site (HISS). The North County FUSRAP site consists of the SLAPS, HISS and 78 vicinity properties (known as SLAPS VPs). The U.S. Department of Energy (DOE) was responsible for the remediation of the FUSRAP sites from the late 1970s until 1998 when the federal government transferred authority to the U.S. Army Corps of Engineers (USACE).

Coldwater Creek from Banshee Road to its confluence at the Missouri River is a SLAPS Vicinity property. The creek has been affected by runoff from the FUSRAP sites in North St. Louis County. Coldwater Creek passes through several north St. Louis County communities including Florissant, Hazelwood, Black Jack and Spanish Lake. Several communities and citizens have raised concerns related to the FUSRAP contamination and Coldwater Creek.

Historically, the DOE collected some sediment and soil samples along Coldwater Creek from Banshee Road to the Missouri River. The USACE has collected and analyzed surface water and sediment samples. In 1994, the Agency for Toxic Substances and Disease Registry (ATSDR) evaluated historical soil and sediment data from Coldwater Creek. Based on the information available at the time, they were unable to establish that a public health risk existed. Since that time, the USACE has undertaken two clean up actions at Coldwater Creek and a clean up of soils at St. Denis Bridge. During 2012 and 2013, the USACE is collecting sediment and soil samples in the creek from McDonnell Boulevard to Byassee/Frost Avenue. When available, this data along with other recent data collected since the USACE clean up actions, will be evaluated for any public health concerns by the DHSS Bureau of Environmental Epidemiology.

Human Exposure Pathways

The risks posed by exposure to an environmental contaminant depend on a number of factors, including the concentration of the contaminant, the frequency of exposure, the duration of exposures and the route of exposure. The Coldwater Creek site contains soil and sediment primarily contaminated with radioactive radium, thorium, and uranium. Although the 1989 Public Health Assessment by ATSDR concluded that there was no known use of the creek for recreation, several current and former residents have more recently stated that recreational use of the creek was and is occurring. External exposure to ionizing radiation from the contaminated soils and sediments in the creek is unlikely to be of concern because of the type of radiation present and the relatively small amount of time a member of the public would spend there. Internal inhalation or, more likely, incidental ingestion of contaminated sediments from around the creek during recreation has more potential for exposure. This could occur by an individual getting contaminated sediment on his or her hands and then placing their hands in or near their mouth before washing them, such as to eat, drink or smoke a cigarette. Coldwater Creek is not used as a drinking water source, so this is not considered a significant route of potential exposure; furthermore, federal drinking water standards for radiation are not exceeded in the Coldwater Creek.

Missouri Department of Health and Senior Services (DHSS)'s Efforts of Monitoring the Incidence and Mortality of Cancers in the Coldwater Creek Area

In response to the local citizens' concerns, the DHSS (former Missouri Department of Health [MDOH]) conducted several studies of the incidence and mortality of leukemia, colon, prostate, breast, lymphoma, melanoma and thyroid cancers in the region. The findings of these studies are summarized as follows:

MDOH Activities

In 1988, MDOH examined mortality and incidence data for five sites in the St. Louis area: HISS, SLAPS, SLDS, Westlake Landfill and the Combustion Engineering plant at Hematite, by census tract for the first four sites and by zip code for the remaining site. Data were obtained from death certificates submitted to the State Center for Health Statistics and included all persons residing in the particular census tract or zip code with a cause of death attributed to any type of cancer during 1979-1987. Incidence data were obtained from the Missouri Cancer Registry (MCR) and included all new cases of cancer reported to MCR between August 1984 and September 1988. Observed and expected deaths were calculated for four age groups and total deaths, by sex. Based on the absence of statistically significant excesses of radiation-associated cancers in the death data and only one potentially suspicious case from the census tract, there appeared to be little evidence for an excess of cancer. Observed versus expected incident cases could not be calculated since the MCR was not yet population-based.

HISS/Latty Avenue/Nyflot

In January 1989, the MDOH's Cancer Inquiry Committee (CIC) contacted the residents of Nyflot Avenue in response to their concerns regarding four cases of leukemia and two other cancers (colon and prostate) in one individual. The residents confirmed the cancer cases reported by the initiator of the inquiry and reported two additional cases. These findings, coupled with knowledge that radioactive contamination existed at three sites: SLAPS, HISS, Futura Coatings Company (FUTURA), as well as along roads formerly used to transport radioactive materials, led MDOH's CIC to recommend expanding the inquiry in February, 1989.

The CIC further interviewed present and past residents, examined medical records and constructed a chronology of deposition of radioactive materials and of diagnosis dates and times of residence of the cancer patients. The result of the interviews and examination of medical records confirmed the existence of the eight cases of cancer found in the preliminary review, plus identified and confirmed two additional cases among past and present residents of the block. The diagnosis dates of these 10 cancer cases ranged from 1963 to 1989, with six of the cancers being diagnosed in the 1980's. Because of the small number of people studied and lack of complete information (total number of residents during the time period studied, their ages, and how long they lived in the area), it was not possible to determine whether the observed number of cases was significantly different from that expected.

Objectives of the Current Study:

The objectives of the current study were to continue the DHSS's efforts of monitoring cancers in this area and responding to local citizens' concerns about the number of people with cancer in the Coldwater Creek area according to the Missouri Cancer Inquiry Protocol.

Study Method:

For this study, the area selected for analysis included the ZIP codes adjacent to the Coldwater Creek: 63031, 63033, 63034, 63042, 63134 and 63138 (the combination of ZIP codes is referred to as the designated area, see Figure 1). The observed number of cancer cases from each ZIP code and the designated area were compared with the expected number based on the incidence rates for the State of Missouri for the period of 1996 through 2004. The analysis was completed using data based on the ZIP code where people were living at the time of diagnosis. Information about the residential history of where patients lived prior to their diagnosis was not available.

When calculating the expected number of cases, the age-, gender-, and race- specific incidence rates for the selected cancers in the State of Missouri were applied to the study population of the corresponding demographic groups to obtain an expected number of cases for the study area (i.e., using the indirect method of rate standardization). Standardized incidence ratios (SIRs), the ratios of the observed to expected numbers of incident cancers, were calculated. Ninety-five percent confidence intervals (CIs) for the SIRs were computed by assuming the observed number to be distributed as a Poisson variable¹. A 95% CI that contains 1.0 means that the observed number of cancers was not significantly different from that expected. Conversely, a 95% CI that does not include 1.0 indicates that the observed number of cases was statistically significantly different, either higher or lower, from the expected number. For the purposes of this report, those numbers will be denoted as “significantly higher” or “significantly lower” than expected.

The stage of diagnosis of female breast, prostate, colorectal, and kidney and renal pelvis cancers in the designated area was compared to that for the State of Missouri. The prevalence of some behavioral risk factors was calculated for the designated area and the State of Missouri using the 2011 county-level study. However, since the sample size for the designated area was small, it was not possible to weight the data to reflect the socio-demographic characteristics of the population in the area. Therefore, the data may not be representative of the population in the area. Also these data are from a survey conducted in 2011, so they do not necessarily reflect risk factor levels 10 or more years before the cancers were diagnosed. However, even though we know these data are not ideal, they are the only risk behavior data we have for the area.

The DHSS Office of Epidemiology and the Missouri Cancer Registry and Research Center at the University of Missouri-Columbia performed the recent analysis to determine if the observed number of cancer cases was higher than expected for each ZIP code and the designated area based on the rates in the State of Missouri.

Results:

Table 1 shows the socio-demographic characteristics of the populations in the designated area based on the 2010 census data. Age and gender compositions in the area are similar to that in the state. There are a higher proportion of African Americans in all ZIP codes, except for ZIP code 63031, which is similar to the state. However, this will not affect the comparisons between observed and expected cancer cases because age, gender and race have been adjusted in the analysis. The proportion of people with less than a high school education or below poverty was higher in ZIP code 63134, lower in ZIP codes 63031, 63033, 63034 and 63042 than in the state. The proportion in ZIP code 63138 is similar to that in the state. Overall, the designated area has a lower proportion of people with less than a high school education or below poverty than the state. Education and poverty were not adjusted in the analysis because individual cancer patient’s education and income data are not collected by the cancer registry. Because women with a higher socio-economic status have a higher risk of breast cancer, we expect a relatively higher incidence of breast cancer in the area than in the state²⁻⁷.

Tables 2-8 show the observed and expected cancer cases in each ZIP code and the designated area.

Table 9 summarizes the findings in tables 2-8 and listed the cancers according to their association with ionizing radiation based on the scientific literature⁸. During 1996-2004, a total of 7,772 incident cases of cancer were reported to MCR from the area, with lung/bronchus/trachea/pleura (1,306), female breast (1,197), prostate (1,196), colon (776), and urinary bladder (332) cancers as the top five types of cancer in the designated area, which are the same as the state. The total number of observed all-cancer cases was significantly higher in ZIP codes 63042, 63134, 63138, and the designated area than that expected based on the state rates. Overall cancer elevation in the designated area over that expected based on the state rates was 5.5%.

For cancers that are frequently associated with ionizing radiation with authoritative risk estimates in scientific studies, the analysis found that the observed number of leukemia cases was not significantly different from expected in each ZIP code and the designated area. The number of incident cases of thyroid cancer was actually significantly lower than expected in ZIP code 63033 and the designated area as a whole, but was not statistically

different between observed and expected cases in other ZIP codes. However, the number of female breast cancer cases in the designated area was significantly higher than expected (Table 9).

For cancers that are occasionally associated with ionizing radiation with valid risk estimates in scientific studies, the analysis found a significantly higher number of lung and bronchus cancer in ZIP codes 63042 and 63134; but a significantly lower number of lung and bronchus cancer in ZIP code 63033 and 63034; a significantly higher number of colon cancer cases in ZIP codes 63033, 63138, and the designated area; and a significantly higher number of multiple myeloma cases in ZIP code 63034, compared to the expected number based on the state rates. The observed numbers of stomach, esophageal, bladder, and ovarian cancer cases were not significantly different from that expected for each ZIP code and the designated area (Table 9).

For cancers that are rarely or never associated with ionizing radiation, the analysis found a significantly higher number of kidney and renal pelvis cancer cases in ZIP code 63033 and the designated area; a significantly higher number of rectum/anus/rectosigmoid cancer cases and larynx cancer cases in ZIP code 63134; and a significantly higher number prostate cancer cases in ZIP codes 63031, 63033, 63034, and the designated area. However, a significantly lower number of cervical cancer cases were observed in ZIP codes 63033, 63138, and the designated area, and a significantly lower number of oral cavity and pharyngeal cancer cases were also observed in ZIP code 63034 and the designated area (Table 9). In addition, the observed number of other rare cancers (combined) that were not listed in the data tables (2-8) was significantly lower in ZIP code 63034 (Table 4).

Table 10 shows the stage of diagnosis of female breast, prostate, colorectal, and kidney and renal pelvis cancers in the designated area and in the state. The stage of diagnosis of female breast, colorectal, and kidney and renal pelvis cancers in the area was similar to that in the state. However, a higher proportion of prostate cancer was diagnosed at an earlier stage in the area than in the state. This is perhaps an indication of increased screening and might be a contributing factor to a higher number of incident cases of prostate cancer.

Table 11 lists modifiable risk factors for female breast, prostate, colorectal, and kidney cancers^{9, 10}. These cancers share common risk factors—unhealthy diets, lack of physical activity, and overweight/obesity. Table 12 shows the prevalence of some risk factors in the designated area and the state. The prevalence of these risk factors (e.g., smoking, physical inactivity) in the area is similar to that in the state, except for lack of breast cancer screening and lack of cervical cancer screening. The prevalence of no Pap smear test in the last 3 years among women age 18 or older was significantly lower in the area than in the state. If this has been consistent over years, it can at least partially explain why the area has a lower incidence of cervical cancer, because the Pap test is also a prevention measure. The prevalence of no mammogram or clinical breast exam in the area is also lower than the state, although it is only marginally significant because of a small sample size. Again the data in table 12 should be interpreted with caution because these data may not be representative of the population in the area.

Discussion:

The MCR data for the period 1996-2004 have more than a 95 percent completion rate and MCR has received gold certificates from the North American Association of Central Cancer Registries (NAACCR). Therefore, the quality of cancer data used in this study is high. However, the possibility of a biased comparison in the incidence of cancers between the designated area and the State of Missouri cannot be completely ruled out. For example, hospitals in the designated area might have a higher cancer-reporting rate than other parts of the State due to a higher awareness. If this is the case, it is expected that there is a greater likelihood of finding a significantly higher cancer incidence in the designated area than in the state when actually there is no difference. In the case of thyroid cancer, the observed number was below the expected, and this is less likely to be explained by under reporting.

The thyroid gland and bone marrow are particularly sensitive to radiation. Leukemia, a type of cancer that arises in the bone marrow, is the most common radiation-induced cancer. The types of cancer linked to radiation are also affected by the part of the body that is exposed. For example, people who get pelvic radiation therapy would not be expected to have higher rates of cancers in the head and neck because these areas weren't exposed to radiation (11). In this study, we found the number of incident cases of leukemia in the area was not significantly different from expected during 1996-2004; however, the number of thyroid cancer cases was significantly lower than expected. This shows that if environmental radiation exposure occurred among the residents in the area, exposure was below a level of public health concern.

Radiation is a moderate risk factor for breast cancer but minimal data is available associating female breast cancer with low to moderate level environmental radiation exposure. It was linked to breast cancer among Japanese atomic bomb survivors due to mixed gamma and neutron radiation, and among young women who received radiation therapy to the chest, especially during puberty⁸. There are many modifiable and non-modifiable risk factors for breast cancer, including age, race/ethnicity, family history and genetics, certain benign breast conditions, exposure to external hormones, never having children, first full-term pregnancy after age 30, drinking alcoholic beverages, lack of physical activity, overweight/obesity, and unhealthy diets. Unhealthy diet, lack of physical activity, and overweight/obesity are risk factors also shared by prostate, colorectal, and kidney and renal pelvis cancers, for which the area also has higher than expected numbers.

Cigarette smoking is the primary risk factor for the development of lung cancer with about 80 to 90 percent of all lung cancers attributable to smoking. The risk of lung cancer increases with the number of cigarettes smoked (i.e., quantity) and the time over which smoking has occurred (i.e., duration). The risk of developing lung cancer decreases each year following smoking cessation as normal cells grow and replace damaged cells in the lung. In addition, tobacco use is a risk factor for kidney and colon cancers and it likely increases the risk of breast cancer and aggressive form of prostate cancer. The number of lung cancer cases was lower in two ZIP codes and higher in another two ZIP codes, and overall, it is not higher in the area. The inconsistencies in the findings of this study suggest the reason for the higher lung cancer incidence in certain ZIP codes might be due to smoking.

There are many risk factors for colon cancer, including older age, being African-American or Ashkenazi Jew, history of colorectal polyp and inflammatory bowel disease, family history, inherited syndromes, type 2 diabetes, unhealthy diet, physical inactivity, obesity/overweight, smoking, heavy alcohol use, and lack of screening among those age 50 or older. Ionizing radiation was found to be linked with colon cancer among Japanese atomic bomb survivors and among women who received a cumulative total of up to 5-10 Gy x-ray treatments in the pelvic area. No associations were found in other studies conducted among nuclear workers, radiologists, or other medical treatments⁸.

While the exact cause of multiple myeloma is not known, the factors that increase the risk of developing multiple myeloma are primarily non-modifiable and include: age (generally 65 and older), African-American, men having slightly higher incidence than women, family history of multiple myeloma and genetic precursor conditions. Exposure to radiation is suspected to increase the risk of multiple myeloma among Japanese atomic bomb survivors, nuclear workers, radiologists, nuclear test participants, etc; however, the association has not been confirmed⁸.

A limitation of this study is that, since there was no inter-census population data available at the U.S. Postal Service ZIP code level, the 2000 Census ZIP Code tabulation areas (ZCTA) populations were used to estimate the population for the ZIP codes and the designated area during 1996-2004. In doing so, an assumption was made that the population changes in the ZIP code and the designated area during 1996-2004 were similar to that of the State of Missouri. To make the number of years before and after the year 2000 the same, we chose the study period of 1996-2004 to reduce bias. Another limitation of this study is that it is a surveillance-based study, which estimates the overall risk for the population in each ZIP code and the designated area. Individuals in the

area may have large variations in both exposure dose and duration. However, the dose and duration data are not available in the cancer registry database and cannot be taken into account in this analysis.

Before drawing conclusions from these data, three aspects of the statistical method need to be considered. First, random fluctuations in the disease occurrence cannot be completely ruled out in explaining differences between observed and expected numbers, even when the difference is statistically significant. The problem of random fluctuation is expected to be more prominent as the study areas become smaller. The second aspect is the power of the statistical test; that is, the probability that a true departure from the expected number can be detected by significance testing. A non-significant difference sometimes reflects low statistical power rather than the absence of differences. In this study, the power of detecting a difference was higher for the designated area than for each individual ZIP code. Third, when making so many comparisons, the play of chance might contribute to the observed findings; e.g., if 100 comparisons are made, 5 might be expected to be significantly high or low based on chance alone.

Conclusions and Recommendations:

In the Coldwater Creek designated area during 1996-2004, the number of incident cases of leukemia was not statistically significantly higher, and the number of incident cases of thyroid cancer was statistically significantly lower than that expected based on the state rates, indicating a greater cancer risk from radiation is unlikely. The number of female breast cancer cases was statistically significantly higher than expected, so was the number of colon, prostate and kidney cancers in the area. These cancers share common risk factors including unhealthy diets, lack of physical activity, obesity, smoking, and diabetes. The DHSS cancer inquiry committee recommends the state and local public health agencies increase cancer prevention and health promotion efforts in the area by promoting healthy eating, regular physical activity, and tobacco control. DHSS will also continue as appropriate to assess available environmental data to assure public health protective cleanup actions at Coldwater Creek and the adjacent sites.

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Table1. Socio-demographic characteristics of the population in the Coldwater Creek area and the State of Missouri

Geographic Area	Total population 2000 Census*	Percentage (%)				
		>64yrs	Male	African American	< High school education**	Below poverty***
<i>63031</i>	50,013	13.71	47.58	11.32	13.33	4.06
<i>63033</i>	45,574	15.73	46.24	43.41	12.44	4.12
<i>63034</i>	16,803	10.65	48.35	28.99	7.44	1.86
<i>63042</i>	19,162	11.88	48.01	18.10	12.62	6.77
<i>63134</i>	14,982	11.60	45.77	57.91	22.54	16.33
<i>63138</i>	21,879	11.09	46.48	53.82	17.70	11.62
<i>Designated area</i>	168,413	13.22	47.04	32.20	13.69	6.24
<i>State of Missouri</i>	5,595,211	13.50	48.62	11.25	18.68	11.74

*Census 2000 population counts from the Census 2000 SF1 table P012 (Sex by Age).

**The populations and percentages of "less than High School Education" are for the population 25 years and older, from the Census 2000 SF3 (sample data) table P037.

***The populations and percentages of "Below Poverty" were for the population in 1999 for whom poverty status was determined, from the Census 2000 SF3 (sample data) table P087.

Table 2. Number of observed and expected incident cases of cancers in ZIP code 63031, 1996-2004

Site	Observed cases	Expected cases*	SIR	Lower 95% CI	Upper 95% CI	Sig
Oral cavity and pharynx	43	48.2	0.89	0.65	1.20	
Esophagus	24	21.8	1.10	0.71	1.64	
Stomach	22	26.3	0.84	0.52	1.27	
Colon excluding rectum	204	197.9	1.03	0.89	1.18	
Rectum and rectosigmoid; anus, anal canal and anorectum	69	74.5	0.93	0.72	1.17	
Liver	17	16.3	1.04	0.61	1.67	
Pancreas	48	51.7	0.93	0.68	1.23	
Larynx	26	22.1	1.18	0.77	1.72	
Lung and bronchus, pleura, trachea, mediastinum and other respiratory organs	403	372.7	1.08	0.98	1.19	
Bones and joints	1	4.1	0.24	0.00	1.36	
Soft tissue including heart	8	13.5	0.59	0.26	1.17	
Melanoma of the skin	59	53.6	1.10	0.84	1.42	
Female breast	361	335.7	1.08	0.97	1.19	
Cervix uteri	19	23.9	0.79	0.48	1.24	
Corpus uteri	60	62.9	0.95	0.73	1.23	
Ovary	31	35.5	0.87	0.59	1.24	
Prostate	307	268.3	1.14	1.02	1.28	SH
Testis	14	10.4	1.35	0.74	2.26	
Urinary bladder	107	92.8	1.15	0.94	1.39	
Kidney and renal pelvis	74	63.1	1.17	0.92	1.47	
Brain and other nervous system	36	32.9	1.09	0.77	1.51	
Thyroid	21	33.4	0.63	0.39	0.96	SL
Hodgkin lymphoma	15	12.1	1.24	0.69	2.04	
Non-Hodgkin Lymphoma	80	88.6	0.90	0.72	1.12	
Myeloma	18	24.4	0.74	0.44	1.17	
Leukemia	64	57.1	1.12	0.86	1.43	
Other	120	135.2	0.89	0.74	1.06	
Other including bone, liver and soft tissue	146	169.1	0.86	0.73	1.02	
Total	2251	2178.8	1.03	0.99	1.08	

*Expected based on age-, gender- and race- specific state rates. SIR: Standardized incidence ratio. CI: Confidence Interval. Sig: Significantly different between observed and expected. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected.

Table 3. Number of observed and expected incident cases of cancers in ZIP code 63033, 1996-2004

Site	Observed cases	Expected cases*	SIR	Lower 95% CI	Upper 95% CI	Sig
Oral cavity and pharynx	37	49.8	0.74	0.52	1.02	
Esophagus	17	25.7	0.66	0.39	1.06	
Stomach	40	31.9	1.25	0.90	1.71	
Colon excluding rectum	250	215.7	1.16	1.02	1.31	SH
Rectum and rectosigmoid; anus, anal canal and anorectum	84	75.9	1.11	0.88	1.37	
Liver	15	22.1	0.68	0.38	1.12	
Pancreas	64	57.5	1.11	0.86	1.42	
Larynx	19	24.9	0.76	0.46	1.19	
Lung and bronchus, pleura, trachea, mediastinum and other respiratory organs	345	401.4	0.86	0.77	0.96	SL
Bones and joints	4	3.5	1.14	0.31	2.93	
Soft tissue including heart	13	13.6	0.96	0.51	1.63	
Melanoma of the skin	42	39.3	1.07	0.77	1.44	
Female breast	348	331.8	1.05	0.94	1.17	
Cervix uteri	13	26.1	0.50	0.26	0.85	SL
Corpus uteri	62	58.3	1.06	0.82	1.36	
Ovary	29	32.7	0.89	0.59	1.27	
Prostate	415	310.7	1.34	1.21	1.47	SH
Testis	2	5.8	0.34	0.04	1.24	
Urinary bladder	87	91.0	0.96	0.77	1.18	
Kidney and renal pelvis	83	65.6	1.27	1.01	1.57	SH
Brain and other nervous system	32	28.2	1.13	0.78	1.60	
Thyroid	14	27.3	0.51	0.28	0.86	SL
Hodgkin lymphoma	13	10.5	1.24	0.66	2.12	
Non-Hodgkin Lymphoma	77	85.2	0.90	0.71	1.13	
Myeloma	26	30.1	0.86	0.56	1.27	
Leukemia	58	57.2	1.01	0.77	1.31	
Other	140	144.7	0.97	0.81	1.14	
Other including bone, liver and soft tissue	172	183.9	0.94	0.80	1.09	
Total	2329	2266.5	1.03	0.99	1.07	

*Expected based on age-, gender- and race- specific state rates. SIR: Standardized incidence ratio. CI: Confidence Interval. Sig: Significantly different between observed and expected. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected.

Table 4. Number of observed and expected incident cases of cancers in ZIP code 63034, 1996-2004

Site	Observed cases	Expected cases*	SIR	Lower 95% CI	Upper 95% CI	Sig
Oral cavity and pharynx	9	17.7	0.51	0.23	0.97	SL
Esophagus	5	8.2	0.61	0.20	1.42	
Stomach	8	9.4	0.85	0.37	1.68	
Colon excluding rectum	75	62.1	1.21	0.95	1.51	
Rectum and rectosigmoid; anus, anal canal and anorectum	27	24.4	1.11	0.73	1.61	
Liver	6	7.2	0.83	0.30	1.81	
Pancreas	11	16.7	0.66	0.33	1.18	
Larynx	3	8.7	0.34	0.07	1.01	
Lung and bronchus, pleura, trachea, mediastinum and other respiratory organs	92	125.2	0.73	0.59	0.90	SL
Bones and joints	1	1.3	0.77	0.01	4.28	
Soft tissue including heart	6	4.6	1.30	0.48	2.84	
Melanoma of the skin	17	15.4	1.10	0.64	1.77	
Female breast	109	108.5	1.00	0.82	1.21	
Cervix uteri	4	8.7	0.46	0.12	1.18	
Corpus uteri	18	19.0	0.95	0.56	1.50	
Ovary	13	10.5	1.24	0.66	2.12	
Prostate	135	102.9	1.31	1.10	1.55	SH
Testis	1	2.6	0.38	0.01	2.14	
Urinary bladder	27	28.3	0.95	0.63	1.39	
Kidney and renal pelvis	27	22.1	1.22	0.80	1.78	
Brain and other nervous system	7	10.1	0.69	0.28	1.43	
Thyroid	11	10.8	1.02	0.51	1.82	
Hodgkin lymphoma	4	3.9	1.03	0.28	2.63	
Non-Hodgkin Lymphoma	24	27.6	0.87	0.56	1.29	
Myeloma	17	8.7	1.95	1.14	3.13	SH
Leukemia	13	17.9	0.73	0.39	1.24	
Other	26	42.7	0.61	0.40	0.89	SL
Other including bone, liver and soft tissue	39	55.8	0.70	0.50	0.96	SL
Total	696	725.3	0.96	0.89	1.03	

*Expected based on age-, gender- and race- specific state rates. SIR: Standardized incidence ratio. CI: Confidence Interval. Sig: Significantly different between observed and expected. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected.

Table 5. Number of observed and expected incident cases of cancers in ZIP code 63042, 1996-2004

Site	Observed cases	Expected cases*	SIR	Lower 95% CI	Upper 95% CI	Sig
Oral cavity and pharynx	14	17.6	0.80	0.43	1.33	
Esophagus	7	8.0	0.88	0.35	1.80	
Stomach	8	9.5	0.84	0.36	1.66	
Colon excluding rectum	80	67.8	1.18	0.94	1.47	
Rectum and rectosigmoid; anus, anal canal and anorectum	31	26.3	1.18	0.80	1.67	
Liver	12	6.2	1.94	0.999	3.38	
Pancreas	20	17.9	1.12	0.68	1.73	
Larynx	10	8.3	1.20	0.58	2.22	
Lung and bronchus, pleura, trachea, mediastinum and other respiratory organs	169	133.8	1.26	1.08	1.47	SH
Bones and joints	0	1.5	0.00	--	--	
Soft tissue including heart	5	5.0	1.00	0.32	2.33	
Melanoma of the skin	24	18.7	1.28	0.82	1.91	
Female breast	135	120.0	1.13	0.94	1.33	
Cervix uteri	8	9.2	0.87	0.37	1.71	
Corpus uteri	18	22.3	0.81	0.48	1.28	
Ovary	18	12.3	1.46	0.87	2.31	
Prostate	118	99.6	1.18	0.98	1.42	
Testis	1	4.0	0.25	0.00	1.39	
Urinary bladder	35	31.9	1.10	0.76	1.53	
Kidney and renal pelvis	24	22.8	1.05	0.67	1.57	
Brain and other nervous system	14	11.8	1.19	0.65	1.99	
Thyroid	7	12.4	0.56	0.23	1.16	
Hodgkin lymphoma	2	4.7	0.43	0.05	1.54	
Non-Hodgkin Lymphoma	36	31.3	1.15	0.81	1.59	
Myeloma	9	8.7	1.03	0.47	1.96	
Leukemia	21	19.9	1.06	0.65	1.61	
Other	52	46.5	1.12	0.84	1.47	
Other including bone, liver and soft tissue	69	59.2	1.17	0.91	1.48	
Total	878	778.0	1.13	1.06	1.21	SH

*Expected based on age-, gender- and race- specific state rates. SIR: Standardized incidence ratio. CI: Confidence Interval. Sig: Significantly different between observed and expected. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected.

Table 6. Number of observed and expected incident cases of cancers in ZIP code 63134, 1996-2004

Site	Observed cases	Expected cases*	SIR	Lower 95% CI	Upper 95% CI	Sig
Oral cavity and pharynx	18	13.3	1.35	0.80	2.14	
Esophagus	8	7.3	1.10	0.47	2.16	
Stomach	8	9.4	0.85	0.37	1.68	
Colon excluding rectum	56	56.4	0.99	0.75	1.29	
Rectum and rectosigmoid; anus, anal canal and anorectum	36	19.6	1.84	1.29	2.54	SH
Liver	8	6.7	1.19	0.51	2.35	
Pancreas	15	15.5	0.97	0.54	1.60	
Larynx	17	7.1	2.39	1.39	3.83	SH
Lung and bronchus, pleura, trachea, mediastinum and other respiratory organs	146	106.8	1.37	1.15	1.61	SH
Bones and joints	2	1.1	1.82	0.20	6.56	
Soft tissue including heart	3	3.9	0.77	0.15	2.25	
Melanoma of the skin	10	8.7	1.15	0.55	2.11	
Female breast	109	89.6	1.22	0.999	1.47	
Cervix uteri	8	8.3	0.96	0.42	1.90	
Corpus uteri	18	15.2	1.18	0.70	1.87	
Ovary	12	8.4	1.43	0.74	2.50	
Prostate	92	86.2	1.07	0.86	1.31	
Testis	2	1.7	1.18	0.13	4.25	
Urinary bladder	25	21.0	1.19	0.77	1.76	
Kidney and renal pelvis	18	17.8	1.01	0.60	1.60	
Brain and other nervous system	9	7.5	1.20	0.55	2.28	
Thyroid	5	7.8	0.64	0.21	1.50	
Hodgkin lymphoma	4	3.2	1.25	0.34	3.20	
Non-Hodgkin Lymphoma	23	21.1	1.09	0.69	1.64	
Myeloma	10	8.9	1.12	0.54	2.07	
Leukemia	20	14.9	1.34	0.82	2.07	
Other	48	38.1	1.26	0.93	1.67	
Other including bone, liver and soft tissue	61	49.8	1.22	0.94	1.57	
Total	730	605.4	1.21	1.12	1.30	SH

*Expected based on age-, gender- and race- specific state rates. SIR: Standardized incidence ratio. CI: Confidence Interval. Sig: Significantly different between observed and expected. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected.

Table 7. Number of observed and expected incident cases of cancers in ZIP codes 63138, 1996-2004

Site	Observed cases	Expected cases*	SIR	Lower 95% CI	Upper 95% CI	Sig
Oral cavity and pharynx	14	18.2	0.77	0.42	1.29	
Esophagus	10	9.0	1.11	0.53	2.04	
Stomach	13	11.4	1.14	0.61	1.95	
Colon excluding rectum	111	76.0	1.46	1.20	1.76	SH
Rectum and rectosigmoid; anus, anal canal and anorectum	24	27.2	0.88	0.57	1.31	
Liver	14	7.9	1.77	0.97	2.97	
Pancreas	24	20.1	1.19	0.76	1.78	
Larynx	5	8.9	0.56	0.18	1.31	
Lung and bronchus, pleura, trachea, mediastinum and other respiratory organs	151	139.5	1.08	0.92	1.27	
Bones and joints	1	1.5	0.67	0.01	3.71	
Soft tissue including heart	4	5.6	0.71	0.19	1.83	
Melanoma of the skin	11	14.7	0.75	0.37	1.34	
Female breast	135	119.9	1.13	0.94	1.33	
Cervix uteri	3	10.7	0.28	0.06	0.82	SL
Corpus uteri	21	20.4	1.03	0.64	1.57	
Ovary	11	11.7	0.94	0.47	1.68	
Prostate	129	107.9	1.20	0.998	1.42	
Testis	2	2.6	0.77	0.09	2.78	
Urinary bladder	41	32.8	1.25	0.90	1.70	
Kidney and renal pelvis	33	23.9	1.38	0.95	1.94	
Brain and other nervous system	9	11.3	0.80	0.36	1.51	
Thyroid	10	11.1	0.90	0.43	1.66	
Hodgkin lymphoma	6	4.7	1.28	0.47	2.78	
Non-Hodgkin Lymphoma	23	31.9	0.72	0.46	1.08	
Myeloma	5	10.6	0.47	0.15	1.10	
Leukemia	26	22.0	1.18	0.77	1.73	
Other	52	52.9	0.98	0.73	1.29	
Other including bone, liver and soft tissue	71	67.9	1.05	0.82	1.32	
Total	888	814.2	1.09	1.02	1.16	SH

*Expected based on age-, gender- and race- specific state rates. SIR: Standardized incidence ratio. CI: Confidence Interval. Sig: Significantly different between observed and expected. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected.

Table 8. Number of observed and expected incident cases of cancers in the Coldwater Creek designated area (63031, 63033, 63034, 63042, 63134, and 63138 combined), 1996-2004

Site	Observed cases	Expected cases*	SIR	Lower 95% CI	Upper 95% CI	Sig
Oral cavity and pharynx	135	164.8	0.82	0.69	0.97	SL
Esophagus	71	80.0	0.89	0.69	1.12	
Stomach	99	97.8	1.01	0.82	1.23	
Colon excluding rectum	776	676.0	1.15	1.07	1.23	SH
Rectum and rectosigmoid; anus, anal canal and anorectum	271	247.8	1.09	0.97	1.23	
Liver	72	66.4	1.08	0.85	1.37	
Pancreas	182	179.3	1.02	0.87	1.17	
Larynx	80	79.9	1.00	0.79	1.25	
Lung and bronchus, pleura, trachea, mediastinum and other respiratory organs	1306	1279.4	1.02	0.97	1.08	
Bones and joints	9	12.9	0.70	0.32	1.32	
Soft tissue including heart	39	46.3	0.84	0.60	1.15	
Melanoma of the skin	163	150.4	1.08	0.92	1.26	
Female breast	1197	1105.5	1.08	1.02	1.15	SH
Cervix uteri	55	86.9	0.63	0.48	0.82	SL
Corpus uteri	197	198.1	0.99	0.86	1.14	
Ovary	114	111.1	1.03	0.85	1.23	
Prostate	1196	975.5	1.23	1.16	1.30	SH
Testis	22	27.1	0.81	0.51	1.23	
Urinary bladder	322	297.9	1.08	0.97	1.21	
Kidney and renal pelvis	259	215.2	1.20	1.06	1.36	SH
Brain and other nervous system	107	101.8	1.05	0.86	1.27	
Thyroid	68	102.8	0.66	0.51	0.84	SL
Hodgkin lymphoma	44	39.2	1.12	0.82	1.51	
Non-Hodgkin Lymphoma	263	285.7	0.92	0.81	1.04	
Myeloma	85	91.4	0.93	0.74	1.15	
Leukemia	202	189.0	1.07	0.93	1.23	
Other	438	460.1	0.95	0.86	1.05	
Other including bone, liver and soft tissue	558	585.6	0.95	0.88	1.04	
Total	7772	7368.3	1.05	1.03	1.08	SH

*Expected based on age-, gender- and race- specific state rates. SIR: Standardized incidence ratio. CI: Confidence Interval. Sig: Significantly different between observed and expected. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected.

Table 9. Types of cancer, their association with ionizing radiation, and significant difference* from expected based on the state rates, 1996-2004

Type of Cancer	63031	63033	63034	63042	63134	63138	Designated Area
Cancers Frequently Associated with Radiation with Authoritative Risk Estimates							
<i>Leukemia</i>							
<i>Thyroid</i>	SL	SL					SL
<i>Female breast</i>							SH
Cancers Occasionally Associated with Radiation with Valid Risk Estimates							
<i>Lung</i>		SL	SL	SH	SH		
<i>Stomach</i>							
<i>Colon</i>		SH				SH	SH
<i>Esophagus</i>							
<i>Bladder</i>							
<i>Ovary</i>							
<i>Myeloma</i>			SH				
Cancers Rarely Associated with Radiation with Uncertain Risk Estimates							
<i>Brain and nervous system</i>							
<i>Kidney</i>		SH					SH
<i>Liver</i>							
<i>Salivary glands</i>							
<i>Non-Hodgkin Lymphoma</i>							
<i>Skin</i>							
<i>Rectum</i>						SH	
<i>Uterus</i>							
<i>Bone</i>							
Cancers Never or Sporadically Associated with Radiation with No Risk Estimates							
<i>Pancreas</i>							
<i>Prostate</i>	SH	SH	SH				SH
<i>Testis</i>							
<i>Cervix</i>		SL				SL	SL
All Cancers				SH	SH	SH	SH

*SH: Significantly higher than expected. SL: Significantly lower than expected.

Table 10. Stage of diagnosis for female breast cancer, prostate cancer, colorectal cancer, and kidney and renal pelvis cancer in the designated area and the State of Missouri

Stage of Diagnosis	Female Breast Cancer				Prostate Cancer				Colorectal Cancer*				Kidney and Renal Pelvis Cancer			
	State		Designated Area		State		Designated Area		State		Designated Area		State		Designated Area	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Localized	21,882	60.0	738	61.7	24,667	75.3	978	81.8	10,694	34.9	339	32.8	4141	56.8	151	58.3
Regional	10,954	30.0	342	28.6	3,730	11.4	122	10.2	11,940	38.9	419	40.5	1227	16.8	39	15.1
Distant	1,773	4.9	73	6.1	1,374	4.2	32	2.7	5,310	17.3	198	19.1	1303	17.9	51	19.7
Unknown	1,890	5.2	44	3.7	2,990	9.1	64	5.4	2,734	8.9	78	7.5	622	8.5	18	6.9
Total	36,499	100	1,197	100	32,761	100	1,196	100	30,678	100	1,034	100	7293	100	259	100

*Colon, rectum and rectosigmoid

Table 11. Modifiable risk factors for female breast, colorectal, prostate, and kidney cancers

Modifiable risk factors	Female breast cancer	Colorectal cancer	Prostate cancer	Kidney cancer
Diet	Poor diet likely increases risk	Poor diet increases risk	Poor diet increases risk	
<i>Fruit and vegetable</i>		Reduce risk	Reduce risk	Reduce risk
<i>Dairy</i>		Low fat milk reduces risk	Dairy product increases risk	
<i>Red meat</i>		Increase risk	Increase risk	
<i>Processed meat</i>		Increase risk		
<i>Fiber</i>		Decrease risk		
Physical activity	Reduce risk	Reduce risk	Reduce risk of aggressive forms	Likely reduce risk
Obesity/overweight	Increase risk after menopause	Increase risk	Increase risk of aggressive forms	Increase risk
Tobacco use	Likely increases risk	Increase risk	Likely increase risk of aggressive forms	Increase risk
Alcohol consumption	Increase risk	Increase risk		
Oral contraceptives	Increase risk			
HRT				
Never having children				
First full-term pregnancy after age 30				
Breast feeding	Decrease risk			
Parity				Likely increase with # of births
STI or inflammation			Increase risk	
High blood pressure				Increase risk
Diabetes		Increase risk		Likely increase risk
Diuretics				Increase risk
Lack of screening		Increase risk after age 50		
Trichloroethylene exposure				Likely increase risk
Ionizing radiation	Increase risk			

HRT: Hormone replacement therapy after menopause
<http://www.cancer.org/acs>

STI: Sexually transmitted infections

Table 12. Prevalence of risk factors in the designated area and the State of Missouri, 2011

Risk Factors	Designated Area*		State of Missouri**
	Number of respondent	Prevalence (%)	Prevalence (%)
<i>Current Smoking among adults age 18+</i>	246	20.4	23.0
<i>Fruit and vegetable consumption < five times per day among adults age 18+</i>	246	86.8	87.4
<i>Physical inactivity among adults age 18</i>	246	25.9	23.7
<i>Obesity among adults age 18+</i>	233	31.9	30.2
<i>No mammogram CBE in last year among women age 40+</i>	109	21.3	30.6
<i>No colonoscopy or sigmoidoscopy in last 10 years among adults age 50+</i>	129	38.2	39.1
<i>No Pap smear in last 3 years among women age 18+</i>	155	13.4***	26.3

Data source: 2011 Missouri County-level Study

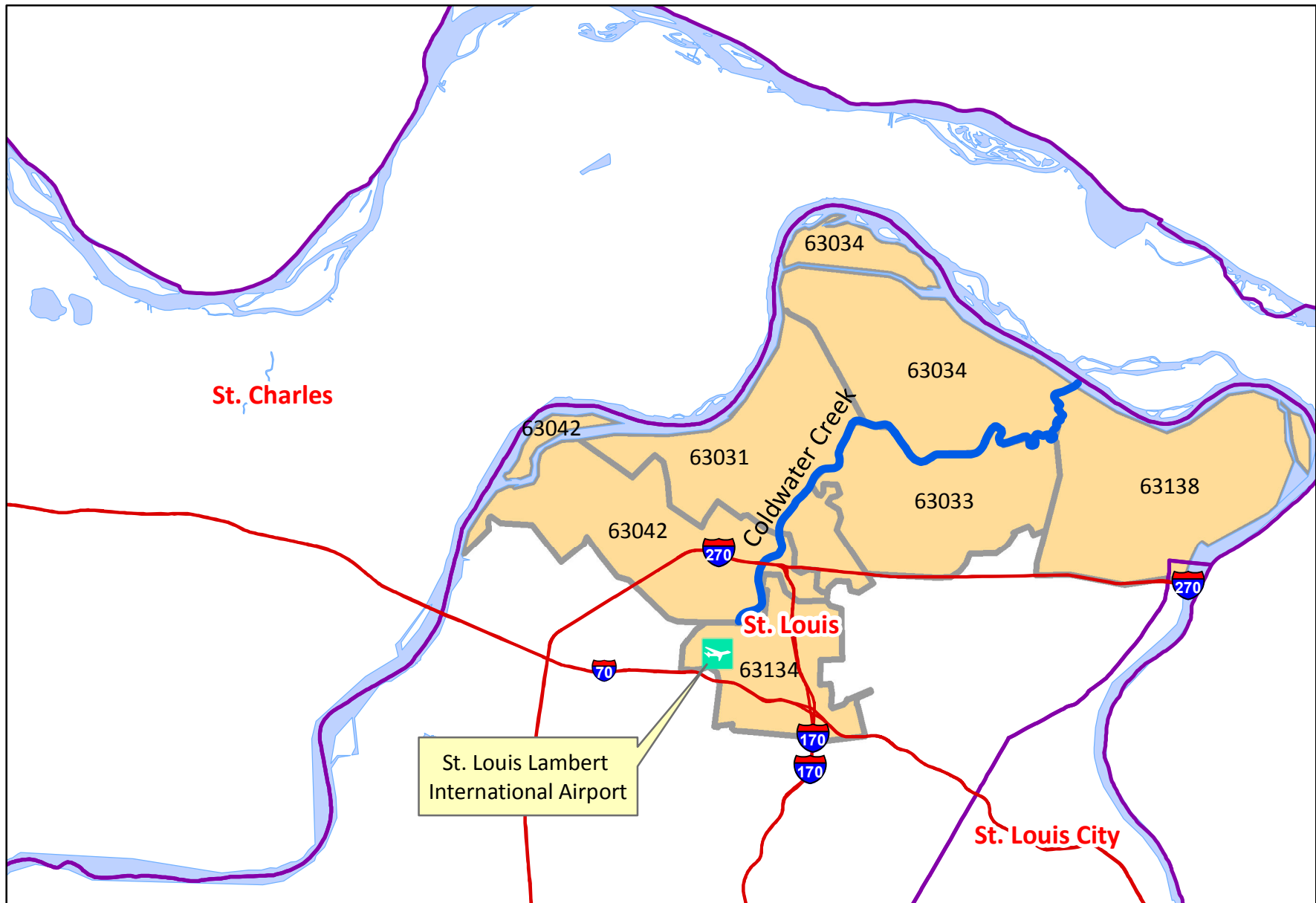
* The data were not weighted for the area and therefore may not be representative of the population in the area

**The number of respondents for the State of Missouri is more than 50,000

*** Significantly lower than the state prevalence

CBE: Clinical Breast Exam

Figure 1. Coldwater Creek and its surrounding ZIP codes



Source: Missouri Department of Health and Senior Services